

# Geometric Sequences

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Score: \_\_\_\_\_ / 26

## Quick Review

A **geometric sequence** multiplies by the same number — the **common ratio**  $r$  — to get from one term to the next. **Explicit formula:**  $a_n = a_1 \cdot r^{n-1}$ . **Recursive:**  $a_1 =$  first term;  $a_n = r \cdot a_{n-1}$ . If  $r > 1$ , the sequence *grows* (exponential growth). If  $0 < r < 1$ , it *shrinks* toward zero (exponential decay). If  $r < 0$ , signs alternate. **Arithmetic vs. geometric:** arithmetic *adds*; geometric *multiplies*. Check by dividing consecutive terms — if you get the same ratio every time, it's geometric.

## PRACTICE

Find  $r$ , write the explicit formula, or find the indicated term.

- |  |  |
|--|--|
| 1. 3, 15, 75, 375, ...; $r$ , $a_n$ _____        | 11. 4, 8, 12, 16, ...; type? _____                 |
| 2. 1000, 200, 40, 8, ...; $r$ , $a_n$ _____      | 12. 4, 8, 16, 32, ...; type? _____                 |
| 3. -2, 6, -18, 54, ...; $a_5$ _____              | 13. 2, 6, 18, 54, ...; $a_8$ _____                 |
| 4. $a_1 = 7$ , $r = 2$ ; $a_6$ _____             | 14. $a_1 = 1$ , $r = \frac{1}{2}$ ; $a_{10}$ _____ |
| 5. $a_1 = 800$ , $r = \frac{1}{2}$ ; $a_5$ _____ | 15. 81, 27, 9, 3, ...; $r$ _____                   |
| 6. $a_1 = 1$ , $r = -3$ ; $a_4$ _____            | 16. $a_1 = 5$ , $r = 2$ ; $a_n$ _____              |
| 7. 5, 10, 20, 40, ...; growth or decay? _____    | 17. $a_2 = 12$ , $a_4 = 48$ ; $r$ _____            |
| 8. 256, 64, 16, 4, ...; growth or decay? _____   | 18. $100 \cdot (0.9)^{n-1}$ ; $a_1$ _____          |
| 9. $a_1 = 6$ , $r = 10$ ; $a_4$ _____            | 19. Is 1, 3, 6, 10, 15 geometric? _____            |
| 10. $a_3 = 18$ , $r = 3$ ; $a_1$ _____           | 20. $a_n = 4 \cdot (-2)^{n-1}$ ; $a_4$ _____       |

## Visual Practice

Use the graph, table, chart, or diagram to answer the question.

21. Find the common ratio from the table.

|       |   |    |    |    |
|-------|---|----|----|----|
| $n$   | 1 | 2  | 3  | 4  |
| $a_n$ | 6 | 12 | 24 | 48 |

Answer: \_\_\_\_\_

22. Find the common ratio from the table.

|       |   |    |    |     |
|-------|---|----|----|-----|
| $n$   | 1 | 2  | 3  | 4   |
| $a_n$ | 5 | 15 | 45 | 135 |

Answer: \_\_\_\_\_

## Word Problems

23. A bacterium culture doubles every hour. Starting with 500 at time 0, how many after 8 hours? \_\_\_\_\_
24. A ball dropped from 80 ft rebounds to  $\frac{3}{4}$  of its previous height each bounce. Height after the 4th bounce? \_\_\_\_\_
25. A car worth \$25,000 loses 15% of its value each year. Value after 5 years? \_\_\_\_\_
26. A scholarship fund is worth \$5000 now and is expected to grow by 4% each year. Write an exponential model and estimate the fund's value after 10 years. \_\_\_\_\_



## Answer Keys

- |  |  |
|--|--|
| <p>1. <math>r = 5, a_n = 3 \cdot 5^{n-1}</math></p> <p>2. <math>r = \frac{1}{5}, a_n = 1000 \cdot (\frac{1}{5})^{n-1}</math></p> <p>3. -162</p> <p>4. 224</p> <p>5. 50</p> <p>6. -27</p> <p>7. growth</p> <p>8. decay</p> <p>9. 6000</p> <p>10. 2</p> <p>11. arithmetic</p> <p>12. geometric</p> <p>13. 4374</p> | <p>14. <math>\frac{1}{512}</math></p> <p>15. <math>\frac{1}{3}</math></p> <p>16. <math>a_n = 5 \cdot 2^{n-1}</math></p> <p>17. <math>r = 2</math> or <math>r = -2</math></p> <p>18. 100</p> <p>19. no</p> <p>20. -32</p> <p>21. 2</p> <p>22. 3</p> <p>23. 128,000</p> <p>24. <math>\approx 25.3</math> ft</p> <p>25. <math>\approx \\$11,092</math></p> <p>26. <math>\approx \\$7,401</math></p> |
|--|--|

### Step-by-Step Tutor Notes

1. Use the clue in the question first, then let the arithmetic finish the job.  $\frac{15}{3} = 5$ . Each term multiplies by 5. So the answer is  $r = 5, a_n = 3 \cdot 5^{n-1}$ .
2. This is a good place to slow down, check the notation, and simplify cleanly.  $\frac{200}{1000} = \frac{1}{5}$ . Shrinking sequence. So the answer is  $r = \frac{1}{5}, a_n = 1000 \cdot (\frac{1}{5})^{n-1}$ .
3. Use the clue in the question first, then let the arithmetic finish the job.  $r = -3$  (alternating signs).  $a_5 = -2 \cdot (-3)^4 = -2 \cdot 81 = -162$ . So the answer is -162.
4. Take it one clear step at a time and keep the original question in mind.  $a_6 = 7 \cdot 2^5 = 7 \cdot 32 = 224$ . So the answer is 224.
5. This is a good place to slow down, check the notation, and simplify cleanly.  $a_5 = 800 \cdot (\frac{1}{2})^4 = 800 \cdot \frac{1}{16} = 50$ . So the answer is 50.
6. Focus on the main idea of the problem, then simplify carefully.  $a_4 = 1 \cdot (-3)^3 = -27$ . So the answer is -27.
7. For a table question, slow down and locate the exact row, column, or cell before calculating.  $r = 2 > 1$ , so terms grow. Exponential growth. This gives growth.
8. Use the clue in the question first, then let the arithmetic finish the job.  $r = \frac{1}{4} < 1$ , so terms shrink. Exponential decay. So the answer is decay.
9. Take it one clear step at a time and keep the original question in mind.  $a_4 = 6 \cdot 10^3 = 6 \cdot 1000 = 6000$ . So the answer is 6000.
10. Use the clue in the question first, then let the arithmetic finish the job.  $a_3 = a_1 \cdot r^2$ , so  $18 = a_1 \cdot 9$ , giving  $a_1 = 2$ . So the answer is 2.
11. Differences: 4, 4, 4. But ratios:  $2, \frac{3}{2}, \frac{4}{3}$  — not constant. So arithmetic, not geometric.
12. Ratios: 2, 2, 2 — constant. Geometric with  $r = 2$ . (And differences are 4, 8, 16 — not constant, so not arithmetic.)
13. Focus on the main idea of the problem, then simplify carefully.  $r = 3$ .  $a_8 = 2 \cdot 3^7 = 2 \cdot 2187 = 4374$ . So the answer is 4374.
14. Take it one clear step at a time and keep the original question in mind.  $a_{10} = 1 \cdot (\frac{1}{2})^9 = \frac{1}{512}$ . So the answer is  $\frac{1}{512}$ .
15. Use the clue in the question first, then let the arithmetic finish the job.  $\frac{27}{81} = \frac{1}{3}$ . Confirm:  $\frac{9}{27} = \frac{1}{3}$ . Decaying sequence. So the answer is  $\frac{1}{3}$ .
16. The first term is 5 and the common ratio is 2. In  $a_n = a_1 r^{n-1}$ , that gives  $a_n = 5 \cdot 2^{n-1}$ .
17. Take it one clear step at a time and keep the original question in mind.  $\frac{a_4}{a_2} = r^2 = \frac{48}{12} = 4$ , so  $r = \pm 2$ . So the answer is  $r = 2$  or  $r = -2$ .
18. Focus on the main idea of the problem, then simplify carefully. At  $n = 1$ :  $100 \cdot (0.9)^0 = 100 \cdot 1 = 100$ . So the answer is 100.
19. Ratios: 3, 2,  $\frac{5}{3}, \frac{3}{2}$ . Not constant, so not geometric. (These are triangular numbers — differences increase.)
20. Take it one clear step at a time and keep the original question in mind.  $a_4 = 4 \cdot (-2)^3 = 4 \cdot (-8) = -32$ . So the answer is -32.
21. Each term is multiplied by 2 to get the next term, so the common ratio is 2.
22. Start with the definition the problem is testing, then apply it directly. Each term is multiplied by 3 to get the next term. So the answer is 3.
23.  $N(t) = 500 \cdot 2^t$ . At  $t = 8$ :  $500 \cdot 2^8 = 500 \cdot 256 = 128,000$  bacteria.
24. First bounce:  $80 \cdot \frac{3}{4} = 60$ . After  $n$  bounces:  $h_n = 60 \cdot (\frac{3}{4})^{n-1}$ . At  $n = 4$ :  $h_4 = 60 \cdot (\frac{3}{4})^3 = 60 \cdot \frac{27}{64} = \frac{1620}{64} \approx 25.3$  feet.
25. Losing 15% keeps 85%, so  $r = 0.85$ .  $V(t) = 25000 \cdot 0.85^t$ . At  $t = 5$ :  $25000 \cdot 0.85^5 \approx 25000 \cdot 0.4437 = \$11,092$ .
26.  $r = 1.04$ .  $V(t) = 5000 \cdot 1.04^t$ . At  $t = 10$ :  $5000 \cdot 1.04^{10} \approx 5000 \cdot 1.4802 = \$7,401$ .



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